

What is claimed is:

1. A method of detecting a distance between a mobile station and a base station, comprising:
 - transmitting a periodical signal from the base station using a broadcast channel, the periodical signal having a periodicity synchronous with a first reference timing generated by a reference timer of the base station;
 - transmitting an other periodical signal from the mobile station to the base station, the other periodical signal having a periodicity synchronous with a second reference timing generated by an other reference timer of the mobile station;
 - receiving the periodical signal by the mobile station transmitted from the base station at the broadcast channel to obtain a phase difference at side of mobile station based on the second reference timing , the phase difference being indicative of a duration from the second reference timing to a received timing of the periodical signal;
 - receiving the other periodical signal by the base station transmitted from the mobile station to obtain an other phase difference at a side of the base station based on the first reference timing , the other phase difference being indicative of a duration from the first reference timing to a received timing of the other periodical signal;
- detecting a reference timing difference between the
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mobile station and the base station based on the phase difference at the side of the mobile station and the other phase difference at the side of the base station;

5 matching the another reference timer of the mobile station with the reference timer of the base station based on the detected reference timing difference; and

obtaining the distance between the mobile station and the base station based on the detected phase difference.

10 2. A method of detecting a position of a mobile station, comprising:

detecting a distance between the mobile station and each of at least three base stations using the distance detecting method according to claim 1; and

15 detecting the position of the mobile station based on the detected distance.

3. A method of detecting a position of a mobile station, comprising:

detecting a distance between the mobile station and 20 each of a plurality of base stations communicating a measuring signal with the mobile station, the plurality of base stations including a main base station with which the mobile station registers a position thereof, and at least two base stations neighboring to the main base 25 station; and

determining an initial value of a communication parameter of a respective measuring signal between the

mobile station and each of the at least two base stations, based on respective distances between the main base station and the at least two base stations neighboring to the main base station, and a value of a communication parameter of the respective measuring signal between the mobile station and the main base station.

4. The method according to claim 3, wherein respective initial values of transmit power and a processing gain of the respective measuring signal to be transmitted from each of the at least two base stations neighboring to the main base station to the mobile station are determined based on the distance between the mobile station and the main base station, respective distances between the main base station and the at least two base stations neighboring to the main base station, and transmit power and a processing gain of the respective measuring signal to be transmitted from the main base station.

5. The method according to claim 3, wherein respective initial values of transmit power and a processing gain of a respective measuring signal to be transmitted from the base station to each of the at least two base stations are determined based on the distance between the mobile station and the main base station, a maximum value in respective distances between the main base station and the base stations neighboring to the main base station, and transmit power and a processing gain of the respective measuring signal to be transmitted to the main base

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station.

6. The method according to claim 1, wherein a measuring signal is communicated between the communication stations including the mobile station and the base stations to detect a distance therebetween based on a propagation time of the measuring signal, and a communication period of the measuring signal is determined based on an allowable error in measuring the distance, a distance resolution in measuring the distance, and relative velocity information therebetween.

7. The method according to claim 6, wherein the mobile station determines the communication period, and notifies the communication period to the base station.

15 8. The method according to claim 6, further comprising:

determining a symbol rate of the measuring signal based on the communication period of the measuring signal and an information amount required for measuring the 20 distance;

obtaining an intermittent time of the measuring signal based on the determined symbol rate, the communication period and the information amount; and turning off the transmit power during the 25 intermittent time for each communication of the measuring signal.

9. The method according to claim 8, wherein the mobile

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station determines the communication period and the symbol rate, and notifies the communication period and the symbol rate to the base station.

10. A method of detecting a velocity of a mobile station,
5 comprising:

detecting a position of the mobile station as a target of position detection while shifting a time, using the method of detecting a position of a mobile station according to claim 3; and

10 detecting the velocity of the mobile station from a difference in distance converted from a change in position per unit time.

11. A distance detecting apparatus equipped in a mobile station comprising:

15 means for receiving a periodical signal transmitted from a base station at the broadcast channel to obtain a mobile side phase difference based on a mobile side reference timing generated by a mobile side reference timer of the apparatus, said periodical signal having
20 a periodicity synchronous with a base station side reference timing generated by a base station side reference timer, and the mobile side phase difference being indicative of a duration from the mobile side reference timing to a received timing of the periodical
25 signal;

means for transmitting an other periodical signal to the base station, the other periodical signal having

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a periodicity synchronous with the mobile side reference timing;

means for matching the mobile side reference timer with the base station side reference timer based on a
5 reference timing difference between the mobile side phase difference and a base station side phase difference detected in the base station based on the base station side reference timing when the other periodical signal is received , said base station side phase difference
10 being indicative of a duration from the base station side reference timing to a received timing of the other periodical signal; and

means for obtaining the distance between the mobile station and the base station based on the detected phase
15 difference.

12. A distance detecting apparatus equipped in a base station comprising:

means for transmitting a periodical signal to a mobile station at the broadcast channel, the periodical
20 signal having a periodicity synchronous with the base station side reference timing generated by a base station side reference timer of the base station;

means for receiving an other periodical signal transmitted from the mobile station to obtain a base
25 station side phase difference based on the base station side reference timing , said other periodical signal having a periodicity synchronous with a mobile side

reference timing generated by a mobile side reference timer of the mobile station, and the base station side phase difference being indicative of a duration from the base station side reference timing to a received timing
5 of the other periodical signal; and

means for obtaining the distance between the mobile station and the base station based on the detected phase difference.

13. A position detecting apparatus comprising:

10 means for detecting a distance between the mobile station and each of a plurality of base stations communicating a measuring signal with the mobile station, the plurality of base stations including a main base station with which the mobile station registers a
15 position thereof, and at least two base stations neighboring to the main base station; and

means for determining an initial value of a communication parameter of a respective measuring signal between the mobile station and each of the at least two
20 base stations, based on respective distances between the main base station and the at least two base stations neighboring to the main base station, and a value of a communication parameter of the respective measuring signal between the mobile station and the main base
25 station.

14. The distance detecting apparatus according to claim
11 , wherein a measuring signal is communicated between

the mobile station and the base station to detect a distance therebetween based on a propagation time of the measuring signal, and a communication period of the measuring signal is determined based on an allowable 5 error in measuring the distance, a distance resolution in measuring the distance, and relative velocity information therebetween.

15. A position detecting apparatus for detecting a position of a mobile station, said apparatus comprising:
10 a communication section that is configured to perform transmission and reception of a measuring signal ; and

 a storage medium in which a position detecting program is stored,

15 wherein the position detecting program comprising:
 a procedure for detecting a distance between the mobile station and each of a plurality of base stations communicating the measuring signal with the mobile station, the plurality of base stations including a main 20 base station with which the mobile station registers a position thereof, and at least two base stations neighboring to the main base station; and

 a procedure for determining an initial value of a communication parameter of a respective measuring signal 25 between the mobile station and each of the at least two base stations, based on respective distances between the main base station and the at least two base stations

neighboring to the main base station, and a value of a communication parameter of the respective measuring signal between the mobile station and the main base station.

5 16. An apparatus to be mounted on a vehicle, said apparatus being provided with a distance detecting apparatus,

said distance detecting apparatus comprising:

10 means for receiving a periodical signal transmitted from a base station at the broadcast channel to obtain a mobile side phase difference based on a mobile side reference timing generated by a mobile side reference timer of the apparatus, said periodical signal having a periodicity synchronous with a base station side reference timing generated by a base station side reference timer, and the mobile side phase difference being indicative of a duration from the mobile side reference timing to a received timing of the periodical signal;

20 means for transmitting an other periodical signal to the base station, the other periodical signal having a periodicity synchronous with the mobile side reference timing;

25 means for matching the mobile side reference timer with the base station side reference timer based on a reference timing difference between the mobile side phase difference and a base station side phase difference

detected in the base station based on the base station side reference timing when the other periodical signal is received , said base station side phase difference being indicative of a duration from the base station side
5 reference timing to a received timing of the other periodical signal; and

means for obtaining the distance between the vehicle and the base station based on the detected phase difference.

10 17. An apparatus to be mounted on a vehicle, said apparatus being provided with a position detecting apparatus,

said position detecting apparatus comprising :
means for detecting a distance between the
15 apparatus and each of a plurality of base stations communicating a measuring signal with the apparatus, the plurality of base stations including a main base station with which the apparatus registers a position thereof, and at least two base stations neighboring to the main
20 base station; and

means for determining an initial value of a communication parameter of a respective measuring signal between the apparatus and each of the at least two base stations, based on respective distances between the main
25 base station and the at least two base stations neighboring to the main base station, and a value of a communication parameter of the respective measuring

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signal between the apparatus and the main base station.

18. The apparatus to be mounted on a vehicle according to claim 16, wherein a measuring signal is communicated between the vehicle and the base station to detect a
5 distance therebetween based on a propagation time of the measuring signal, and a communication period of the measuring signal is determined based on an allowable error in measuring the distance, a distance resolution in measuring the distance, and relative velocity
10 information therebetween.

19. A mobile communication system including a mobile station having a position detecting apparatus and a base station having a position detecting apparatus,
each of said position detecting apparatus
15 comprising:

means for detecting a distance between the mobile station and each of a plurality of base stations communicating a measuring signal with the mobile station, the plurality of base stations including a main base
20 station with which the mobile station registers a position thereof, and at least two base stations neighboring to the main base station; and

means for determining an initial value of a communication parameter of a respective measuring signal
25 between the mobile station and each of the at least two base stations, based on respective distances between the main base station and the at least two base stations

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neighboring to the main base station, and a value of a communication parameter of the respective measuring signal between the mobile station and the main base station.

- 5 20. The position detecting apparatus according to claim 15, wherein the storage medium is selected from the group consisting of a semiconductor memory, a magnetic storage medium, an optical storage medium and an optomagnetic storage medium.